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ABSTRACT

This report surveys the use of technology in mathematics at New Jersey's community colleges. Of the 19 colleges contacted, 16 responded. The first section discusses the use of graphics calculators in mathematics courses. A table summarizes the courses in which graphics calculators are used, whether they are recommended or required, and the brands used. The most widely used machine is Texas Instruments' TI-82/83, which most students buy at the store and use for upper-level math courses such as calculus or algebra. The next section of the report addresses computer use in mathematics courses. Of the 15 colleges who use technology, three do not use computers, only calculators. Both basic and advanced mathematics courses were found to use computers, with DERIVE, an easy-to-use computer algebra system that incorporates graphing and symbolic manipulation, being the most popular program. The report concludes with a discussion on Internet use, the availability of technology facilities and services on the surveyed campuses, and problems or comments regarding technology use in mathematics courses. A list of colleges responding to the survey, as well as the technology usage survey itself, are also provided. (YKH)

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# Survey of Technology Use in Mathematics at New Jersey's Community Colleges

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In: Issues of Education at Community Colleges:
Essays by Fellows in the Mid-Career Fellowship Program at Princeton University

JC 980314

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Probably the first graphics calculator to appear was the Casio fx-7000G, followed closely by the first symbolic manipulation calculator Hewlett Packard's HP-28. This was around 1988; the succeeding decade has seen a family of TI-80-Somethings, Casios, Sharps, and HP's, as well as a wealth of computer software that can do graphical, symbolic, and numeric operations for all levels of mathematics.

I attended my first graphics calculator workshop, sponsored by the New Jersey Department of Higher Education, in 1989. Since then, I've attended numerous conferences, workshops, and minicourses dealing with calculators and computers in mathematics education. From 1991 to 1994, I was project director for two National Science Foundation funded grants which helped a group of New Jersey and Pennsylvania two year colleges introduce graphics calculators into precalculus and calculus courses. Computer software seemed to us to be a natural followup to these endeavors, and now the Internet has exploded on the scene.

Within a decade, we have seen countless high schools start to use graphics calculators in most mathematics courses. Calculators are now required on the Scholastic Aptitude Test (SAT), both regular and the Mathematics Achievement Tests; and graphics calculators are required on the Advanced Placement Tests in Calculus. In the three years prior to the implementation of that mandate, the College Board through Clemson University sponsored a massive effort to train as many AP Calculus teachers as possible in the effective usage of the TI-82 and HP-48; those attending summer workshops at Clemson would in turn train those teachers who couldn't attend.

It is not my intention in this paper to make a case for or against using technology in mathematics. I will not present a survey of the literature for articles by pro-/anti-technology advocates citing its effectiveness/ineffectiveness. (I've been told the technology debate in mathematics is as heated as the quill pen versus pencil debate was many, many years ago!)

From my own experiences, I believe that anything is effective to someone. Are graphics calculators and computer algebra systems effective? Yes, with some students, they are -- maybe even with the majority of students. That isn't the point. It's not a matter of if the technology works. These things EXIST. Many high schools (and even some primary schools!) are lightyears ahead of us in their use. Parents go out and buy them for their kids. Students will use them in the workplace and/or at the four-year college to which they transfer. We would be shortchanging them if we ignored this important aspect of their education. It is our responsibility to see that these machines are used correctly, to the best possible advantage. How we do that, is beyond the scope of this paper. There are perhaps thousands of books and articles dealing with graphics calculators or computers in a vast array of mathematics courses.

After a decade of activity and change, it seems a good idea to take stock of what New Jersey's community college mathematics departments are doing. Of the nineteen colleges surveyed, sixteen have responded for this report. Only one of them currently does nothing; some in the department want change in the near future, but debate whether to use graphics calculators or computers. Perhaps what other two year colleges are doing may help them decide.



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## REGARDING CALCULATORS .....

The first section of the survey dealt with graphics calculators. The table below summarizes the courses in which graphics calculators are used, whether recommended or required in how many schools, and the brands used.

TABLE ONE
Calculator Usage

| Course | Recommended | Required | Brand(s) |
|---|---|---|---|
| Trigonometry | | 1 | TI-82 |
| Math Analysis Bus | 1 | | TI-81 |
| Precalculus * | 2 | 7 | TI-82 |
| Calculus I | 5 | 6 | HP-48, TI-etc |
| Calculus II | 5 | 4 | HP,TI,Sharp9300c |
| Calculus III | 5 | 4 | same |
| Intermediate Alg. | 3 | | TI-82 |
| Col. Alg.& Trig. | 1 | 2 | TI-81/82/83 |
| Applied Calculus | 2 | 3 | TI-82/83/85 |
| Discrete Math | 1 | 1 | |
| Linear Algebra | 1 | 3 | TI-82/83, HP48 |
| Differential Eq. | 3 | 2 | TI-82/92, HP48,Sharp9300c |
| Statistics ** | 3 | 3 | TI-82/83 |
| Finite Math | 1 | 2 | |
| College Algebra | 3 | | TI-82/83 |

* Some colleges have both a Precalculus I & II; some don't.

** Some colleges have Statistics I & II; others have two or three different statistics courses based on level or program.

No mention was made of any Developmental Mathematics courses; one obvious reason is that these machines are "over-kill" at the level of Basic Skills. (Whether any kind of calculators are used in Developmental Mathematics is another issue beyond the intention of this survey.)

The most widely used machine is Texas Instruments' TI-82/83. Other models used are the HP-48 (2 colleges), TI-85 (three colleges), TI-92 (two colleges) and the Sharp 9300(c). Only one college allowed students to select the model/brand they wanted.

As for how the students obtain their calculators, most buy them from any store. One college rents them through the Mathematics Department, and one through the college bookstore. Three lend them without any fee; these colleges seem to have the same procedure and problems. Students' records are flagged and students who do not return the calculator are blocked from future registration. However, exceptions are made during advance (early) registration for current students; so tracking the calculators is a nuisance. One college has two class sets that travel to various courses for in-class use only.

COMPUTERS ....

Of the fifteen colleges who use technology, three do not use computers; they require/recommend graphics calculators only. Atlantic Community College recommends the TI-82 for College Algebra and Intermediate Algebra. However Camden County College and Middlesex County College require graphics calculators in (almost) all their mathematics offerings. Camden lacks the computer facilities. Middlesex has the facilities and used Derive and Minitab for several years, but no longer does so.

Twelve colleges make use of available computer software in the same previously mentioned courses, in some cases in addition to the graphics calculators, and in some cases instead of the graphics calculators . This time, however, Arithmetic and Elementary Algebra classes also partake of Computer-Assisted-Instruction at five of the colleges. Eleven use computers in Calculus I-II- III; Mercer County College uses computers in only one section of Calc I. Five use software for Differential Equations. Nine also use software in Statistics. Table Two below summarizes all the courses effected. As for how the computer is used, nine give in-class demonstrations; ten have some variety of class-connected labs; and ten give out of class assignments.



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TABLE TWO
Computer Use

| Course | Number of Schools of 12 |
|---|---|
| Arithmetic (Basic Math) | 5 |
| Elementary Algebra | 5 |
| Intermediate Algebra | 2 |
| Precalculus * | 3 |
| Business Precalculus | 1 |
| Business Calculus | 1 |
| Calculus I # | 12 |
| Calculus II | 11 |
| Calculus III | 11 |
| Differential Equations | 5 |
| College Alg. & Trig. | 1 |
| Linear Algebra | 3 |
| Finite Math | 2 |
| Discrete Math | 1 |
| Statistics ** | 9 |

* Some schools have a Precalculus I & II.
# Mercer CC uses computers in only one section of Calc I.
** Some schools have Statistics I & II; some have two or three different courses due to levels or programs.

By far the most popular program, used by ten colleges, is DERIVE, an easy-to-use computer algebra system that incorporates graphing and symbolic manipulation, and can be used from Precalculus up to Differential Equations and Linear Algebra. Next popular was Minitab, a statistical program; Converge, and MathCad . Table Three shows the various software packages used.

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TABLE THREE
Software in Use

| Software Package | Number of Colleges Using It |
|---|---|
| Derive | 10 |
| Converge | 5 |
| Phaser | 1 |
| Minitab | 5 |
| MathCad | 5 |
| MPP (freeware Naval Academy) | 1 |
| Statdisk | 2 |
| Matrixpad | 1 |
| Bestgrapher | 1 |
| SAS | 1 |
| Maple | 1 |
| MATLAB | 1 |
| Publishers Stuff! | 2 |

THE INTERNET....ETC.....

Regarding the Internet, four colleges don't use it at all, but not necessarily the same four who don't use computer software in their courses. At least one of them (Ocean CC) isn't even connected, and Camden CC has only one computer connected to the Web! Seven use the Internet for students' research projects, three for demonstrations in class, and four for faculty research ( for two colleges, that's their only use of the Internet.). Two colleges even have course home pages.

One college (Brookdale CC) reported having a classroom lab facility devoted to mathematics. Six have computer labs available to students; three have computers available in Learning/Resource Centers. Two report labs with Internet access for students (Union and Hudson). Five colleges report that all faculty have computers in their offices.

Only two colleges reported that adjuncts don't use the technology; at twelve, both full-time and adjunct faculty made use of technology in their courses. As for training, seven colleges provided workshops on the computer software and calculators for faculty members, with five specifically targeting adjuncts. Five provided no training at all.

Comments about problems or just general comments were solicited. Regarding graphics calculators, only the previously mentioned loaner problem was cited. Lack of facilities was cited a few times with respect to computers. General problems cited included lack of interest from the faculty with only a small number of faculty willing to use technology; lack of training; lack of skills; lack of administrative support or encouragement. The survey did not ask for perceived or verified results on student learning or enthusiasm in using the technology. A copy of the survey, which was sent to



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the MATYC-NJ (Mathematics Association of Two-Year Colleges of New Jersey) representative on each campus, is appended to this report.

Colleges Responding to the Survey

Atlantic Community College
Bergen Community College
Brookdale Community College
Burlington County College
Camden County College
County College of Morris
Cumberland County College
Essex County College
Hudson County Community College
Middlesex County College
Mercer County Community College
Ocean County College
Passaic County Community College
Raritan Valley Community College
Sussex County Community College
Union County College

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TECHNOLOGY USAGE SURVEY

NAME _____

COLLEGE _____

PHONE _____ EMAIL _____

1. Are graphing calculators used in any of your college mathematics courses?
   NO _____ (skip to questions # 4)
   YES _____

2. In which courses?

| Category/ title | Brand /Mod. Calc. | Required or Recomm. |
|---|---|---|
| | | |



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2. Any comments on the model: _____

_____

_____

3. If calculators are required, how is this handled:

a. Students purchase them _____

from any store _____

at college book store _____

b. students rent them from college _____

through the book store _____

through the mathematics department _____

c. Calculators are loaned with no fee _____

Any comments on how this process works? _____

_____

_____

4. Are computers used in any mathematics courses at your college?

NO _____ (skip to "end of survey")

YES _____

5. How are they used: check all that apply

a. In class for demonstration _____

b. In lab setting _____

c. For outside of class assignments _____

d. For Internet access _____

6. In which courses are computers used?

| CAT # / TITLE | ANY COMMENTS |
|---|---|
| | |



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7. what software packages are used? How often & what courses?

Derive
Converge
Mathematica
M P P
Math Cad
Mat Lab
: (Z)
Maple
MAC Math
Phaser
other?

8. Do your faculty use resources on the Internet?

Yes _____
No _____

9. If yes, how?

In class demonstrations _____
Student research _____
Course home page _____

10. What facilities are available to your faculty and students?

11. Who uses this technology?

Full time faculty? _____
Adjuncts? _____

12. Did your department /college provide any training in the use of these technologies, particularly for adjuncts?

_____
_____
_____

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"END OF SURVEY"

If your department doesn't use any or specific technologies, why not?

_____

_____

_____

Would you mind being interviewed if I need further information? Particularly if your Dept. doesn't use any technology.

_____

E- mail or phone preferred? _____
Best time to call _____

Thanks for your help!

*Please use the enclosed self-addressed stamped envelope to return the survey to:*

*Prof. Jean Lane*
*Mathematics Department*
*Union County College*
*1033 Springfield Avenue*
*Cranford, NJ 07016*

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